CHAPTER 9
GEOSPATIAL DATA AND SYSTEMS

9-1. Introduction. This chapter discusses the geospatial data and geospatial data system (GD&S) considerations that should be addressed by the project team for an OE project. The project team should develop project-specific GD&S requirements for inclusion in the SOW for each OE project. Attachment 9-1 is a checklist of GD&S considerations.

9-2. Requirements for the Acquisition and Access of Geospatial Data.

    a. This chapter presents guidance in developing GD&S requirements associated with an OE project, specific SOW specifications, and technical or management considerations. ER 1110-1-8156, Policies, Guidance, and Requirements for Geospatial Data and Systems, establishes general criteria and presents policy and guidance for the acquisition, processing, storage, distribution, and utilization of geospatial data.

    b. EM 1110-1-2909 identifies standards for GD&S acquired, produced, and/or utilized in support of an OE project. Specifications for obtaining this data should be "performance-based" and not overly prescriptive or process oriented; they should not be a procedural instruction. Project specifications should set forth the end results to be achieved and not the means or technical procedures used to achieve those results. They should succinctly define the GD&S requirements as derived from the functional project requirements developed by the project team and reference EM 1110-1-2909 and other applicable industry standards.

9-3. Data Quality Objectives. The project team should review the archival records of the project area or installation in which the project is located and inventory all existing GD&S information prior to developing site-specific data quality objectives.

    a. Geospatial Data System. The project team should review the extent of Geospatial Data Systems (GDS) currently utilized by the OE MCX, Design Center, district, project sponsor, and stakeholders. Any automated system that employs or references data using absolute, relative, or assumed coordinates is considered a GDS. These include GIS, Land Information Systems (LIS), Remote Sensing or Image Processing Systems, CADD systems, and Automated Mapping/Facilities Management (AM/FM) systems. The selected GDS should accomplish today's mission but also allow for future reuse or use of the geospatial data by others without translation. Production of geospatial data in multiple formats for distribution or use should be avoided wherever possible.

    b. Spatial Coordinate Reference System. All OE projects should be adequately connected to nationwide or worldwide geographic reference systems. All geospatial data should be indexed to existing local, state or national control monuments and referenced to an appropriately recognized installation, local, state, or worldwide coordinate system as specified by the project

team. The project team should select a spatial coordinate reference system that is compatible with existing district or project sponsor GD&S activities.

   c.   Geospatial Data Standards. GD&S users need geospatial data standards to manage this data, reduce redundant data, make systems more efficient, and lower project costs. The Tri-Service CADD/GIS Technology Center standards for naming conventions, common GIS layers, and symbology should be specified for all deliverables of collected geospatial data. The project team should develop additional site-specific standards for the format, transfer, and storage of all geospatial data consistent with EM 1110-1-2909. Factors influencing formulation of project-specific standards include:

   (1) Compatibility with selected GDS without modification or additional software;

   (2) Format of existing digital data and geospatial-referenced mapping; and

   (3) Usability by all parties of concern, including stakeholders.

   d.   Measurement Units. Geospatial data produced in support of an OE project should be recorded and plotted in the units prescribed for the project by the district or project sponsor.

   e.   Accuracy. Every geospatial data element contains errors of a certain magnitude due to a variety of causes. The project team should evaluate data requirements and develop acceptable limits of error (accuracy and precision) based upon the nature and purpose of the GD&S.

   f.   Quality Control.

   (1) The primary goal of data quality management is to ensure consistent and measurable accuracy throughout the database. Consistency is achieved through the use of documented, approved production procedures. Following production, an assessment of the quality of the data set should be conducted to measure the achievement of expected results. The project team should establish the level of production control and rigor with which quality assessments should be made consistent with the project-specific GD&S requirements. GD&S with stringent accuracy and consistency requirements may need to have detailed procedural documentation, a completion signature for each production step, and a comprehensive assessment of accuracy. Conversely, smaller-scale GD&S developed for production of background geospatial data may have much less stringent production documentation requirements and only a cursory accuracy assessment.

   (2) The project team should state in the SOW that quality control of the GD&S activities and products should be performed by the contractor and include independent tests which may be periodically reviewed by the government. Therefore, USACE quality assurance and testing functions will focus on whether the contractor meets the required performance specifications.

g.   Reliability. The development of an effective GDS facilitates a systemized approach to an OE project using all digital data and life cycle management of all applicable geospatial data. The project GD&S should provide a full digital record of all on-site activities with a reproducible trail to support ongoing and future Administrative Record decisions.   The GD&S designated in the SOW by the project team should provide reliable results, support greater overall productivity, and lower total project costs.

9-4.   Statement of Work.

a.   The GD&S standards and specifications for each OE project SOW should be prepared by project team personnel with detailed knowledge of project history, archival information, various GDS platforms, and project-specific data requirements.

b.   The project team should ensure that the OE project SOW specifies that a qualified GIS manager should manage all GDS activities. The SOW should specify that the individual will have a minimum of three years of direct experience managing geospatial data systems within the system environment (i.e., Microstation MGE or ArcInfo).

9-5.   Planning Considerations. Each OE project requires selection of an appropriate GD&S that will accomplish the end objective without wasting manpower, time, and money. The project team should ensure that the following items are considered when planning for GD&S.

a.   GD&S considerations for Work Plan preparation.

(1) Prior to initiating field activities, Work Plan chapters should be prepared to describe the project requirements, proposed technical methodologies and procedures, and equipment recommendations for all GD&S activities that will take place during an OE project.

(2) The following elements should be addressed in the Work Plan:

(a) Locating existing Geospatial Data (types and accuracy);

(b) Newly collected geospatial data (types, accuracy and location);

(c) Proposed system methods and procedures (hardware and software, personnel, work instructions/data format, data processing, analysis support, communication/data transfer, and data storage);

(d) Quality control (data validation); and

(e) Deliverables.

b. Spatial Data Reference System. Unless otherwise specified, all horizontal control will be based on either the English or metric system and referenced to the NAD83 and the State Plane Grid System for the project location. Vertical control, if required, will also be based on either the English or metric system and referenced to the NAVD88.

c. Mapping. The project team should review the extent of mapping requirements to be included in each OE project SOW. The project team should assure that the SOW states that all maps and drawings to be provided under the task are sealed and signed by the RLS/PLS. Tri-Service CADD/GIS Technology Center standards should be specified for all location survey and mapping deliverables of CADD, GIS, and other spatial and geospatial data in accordance with EM 1110-1-2909. The project team should ensure that the following maps are provided:

(1) Location Maps. A location map showing the project site and surrounding points of interest should be required. The map(s) should be produced at a scale no smaller than 1:2,400 or 1":200'.

(2) Project Maps.

(a) A map of all project-related points of interest should be produced and electronically delivered at a scale specified by contract requirements. The Project Map should show the location and identification of all of the project control monuments recovered and/or established at the site in support of the OE response, local project controls, significant planimetric features, project boundaries, and property boundaries (if in close proximity to project boundaries). The location of recovered UXO/OE should also be plotted and identified on the map unless individual grid maps are also required.

(b) General Project Map requirements should also include grid, magnetic, and true north arrows with their angular differences; grid lines or tic marks at systematic intervals with values shown on the edges of the map; and a legend showing the standard symbols used for the mapping.

(3) Grid Maps. If required, individual maps for each grid should be prepared at a scale no smaller than 1:2,400 or 1":200'. The Grid Maps will include the plotted location of each surface UXO/OE and verified subsurface UXO/OE recovered and each subsurface geophysical anomaly within the grid not completely investigated. Other notable planimetric features within the grid will also be sketched on the individual Grid Maps.

d. Design File Requirements.

(1) An overall planimetric design file will be created and will be digitized into the appropriate GDS file at an elevation of zero. If contours and spot elevations are required, all data will be digitized into a second design file with each element (contours and spot elevations) at their correct elevation.

(2) Cut sheet plots and views into the project data will be created by referencing the planimetric and contour files. Each sheet will be a standard metric A-1 drawing, which is 841 mm by 594 mm (33.1 inches by 23.4 inches). Each sheet will have a standard border, a revision block, a complete index sheet layout, a bar scale, a legend, grid lines or a grid tic layout in feet or meters, a True North, a Magnetic North and a Grid North arrow, with their differences shown in minutes and seconds. Each sheet will be plotted at the horizontal scales required.

(3) The cell library used will be attached and provided with the digital data set along with all other supporting files or data. All production and work files will be fully documented into a concise data manual. This manual will include all specific information required for an outsider to be able to recreate all products and determine the location, names, structures and association of the data. The manual will be included as an ASCII file titled READ.ME that is included with all distributed digital data.

9-6. Deliverables.

a. No digital data will be acceptable until proven compatible with the GDS designated in the SOW. All revisions required to achieve compatibility with the SOW-designated GDS will be done at the contractor's expense.

b. Deliverables will be submitted to the project team in accordance with contract requirements. Whenever appropriate, deliverables should be submitted electronically. Deliverables which should be submitted upon completion of the OE project include:

(1) Unique items created and/or used to create the end products and the narrative and description required by the SOW;

(2) Digital data in the media as specified in the SOW along with cell library and all other supporting files; and

(3) Data manual documenting all production and work files.

ATTACHMENT 9-1
GEOSPATIAL DATA AND SYSTEMS CHECKLIST

Project Name:
Project Location:
Design Center POC:
Preparer's Name and Title:
Date of Preparation:

	Y	**N**	**N/A**

SOW Requirements

1. Has the Geospatial Data and System (GD&S) task in
    the SOW been prepared by project team personnel with
    a detailed knowledge of project history and archival
    information, site conditions, site-specific data
    requirements and GD&S platforms?

2. Does the SOW state that all GD&S activities should be
    managed by a qualified GIS manager with a minimum
    of 3 years direct experience managing geospatial data
    systems within the system environment to be used for
    the project (e.g., Microstation MGE or ArcInfo)?

3. Does the SOW specify the Geospatial Data System
    (GDS) to be used on the project:

    - Were the systems currently utilized by the OE
      MCX, Design Center, district, project sponsor
      and stakeholders considered in choosing the
      project GDS?

    - Will the chosen system avoid production of
      geospatial data in multiple formats for
      distribution or use?

    - Will the chosen system accomplish the current
      mission but also allow for future reuse or use of
      the geospatial data by others without
      translation?

	Y	**N**	**N/A**

- Will the chosen system provide reliable results, support greater overall productivity and lower total project costs?

4. Does the SOW specify the spatial coordinate reference system to be used?

5. Is the chosen spatial coordinate reference system compatible with the existing district or project sponsor GDS activities?

6. Does the SOW require that location surveys be connected to existing local, state or national control monuments and referenced to an appropriately recognized installation, local state, or worldwide coordinate system as specified by the OE project team?

7. Does the SOW specify that Tri-Service CADD/GIS Technology Center standards for naming conventions, common GIS layers, and symbology will be used for all deliverables?

8. Does the SOW specify additional site-specific standards developed by the project team for the format, transfer, and storage of all geospatial data consistent with EM 1110-1-2909?

9. Were the following factors considered by the project team when developing site-specific standards:

- Compatibility with selected GDS without modification or additional software?

- Format of existing digital data and geospatial referenced mapping?

- Usability by all parties of concern including stakeholders?

10. Does the SOW prescribe the units to be used in recording and plotting geospatial data, as specified by the district or project sponsor?

	Y	N	N/A

11. Does the SOW specify the minimum acceptable limits for accuracy and precision based on the nature and purpose of the GD&S?

_____   _____   _____

12. Does the SOW require contractor quality control of GD&S activities and products, including independent tests that may be periodically reviewed by the government?

_____   _____   _____

13. Has the project team established the level of production control and rigor with which quality assessments must be made consistent with the project-specific GD&S requirements?

_____   _____   _____

14. Are the following deliverables specified in the SOW:

- Unique items created and/or used to create the end products and the narrative and description required?

_____   _____   _____

- Digital data in the media as specified in the SOW along with cell library and all other supporting files?

_____   _____   _____

- Data manual as an ASCII file documenting all production and work files necessary for an outsider to recreate all products and determine the location, names, structures and associations of the data, such as layer description, weights, colors, symbology, referencing of files, etc.?

_____   _____   _____

Planning Considerations

Are the following considerations for GD&S activities addressed in the OE project SOW?

1. Locating of Existing Geospatial Data:

- Types?

_____   _____   _____

- Accuracy?

_____   _____   _____

2. Newly Collected Geospatial Data:

- Types?

_____   _____   _____

- Accuracy?

_____   _____   _____

	Y	N	N/A
• Location?	___	___	___
3. Proposed System Methods and Procedures:			
• Hardware and Software?	___	___	___
• Personnel?	___	___	___
• Work Instructions/Data Format?	___	___	___
• Data Processing?	___	___	___
• Analysis Support?	___	___	___
• Communication/Data Transfer?	___	___	___
• Data Storage?	___	___	___
4. Quality Control:			
• Data Validation?	___	___	___
5. Interim Deliverables?	___	___	___
6. Final Deliverables?	___	___	___